

**CLAIMS**

**What is claimed is:**

- 5           1. An implantable medical device comprising:  
            a sensing system configured to sense atrial activity of a heart;  
            a discriminator, coupled to the sensing system, that  
            determines if a selected characteristic of the sensed atrial activity  
            satisfies a predetermined criterion thereby indicating an interatrial  
10           conduction disturbance; and  
            a pulse generator, coupled to the discriminator, that delivers  
            atrial arrhythmia prevention pacing pulses to the heart responsive to  
            the discriminator determining that the selected characteristic of the  
            sensed atrial activity satisfies the predetermined criterion.
- 15           2. The implantable medical device of claim 1, wherein the selected  
            characteristic of the sensed atrial activity is P-wave duration and wherein  
            the implantable medical device a P-wave duration timer coupled to the  
            detector that determines durations of detected P-waves.
- 20           3. The implantable medical device of claim 1, wherein the selected  
            characteristic of the sensed atrial activity is average P-wave duration and  
            wherein the implantable medical device includes a P-wave duration timer  
            coupled to the sensing system that determines durations of selected P-  
25           waves and a duration averager coupled to the P-wave duration timer that  
            averages determined P-wave durations.
4. The implantable medical device of claim 1, wherein the sensed  
            characteristic of the sensed atrial activity is interatrial delay time, wherein  
30           the sensing system includes a first sensor that senses right atrial

activations and a second sensor that senses left atrial activations, and wherein the implantable medical device includes an interatrial delay timer coupled to the first and second sensors that times interatrial delay times between activations detected by the first sensor and the second sensor.

5

5. The implantable medical device of claim 1, wherein the atrial arrhythmia prevention pacing pulses are atrial overdrive pacing pulses and wherein the pulse generator circuit includes an atrial overdrive pulse generator that provides atrial overdrive pacing pulses to the heart when the selected characteristic of the sensed atrial activity satisfies the predetermined criterion.

10

6. The implantable medical device of claim 1, wherein the sensing system senses P-waves of the heart and wherein the pulse generator circuit includes an atrial pulse generator that delivers an atrial pacing pulse a delay time after each sensed P-wave.

15

7. The implantable medical device of claim 6, further including a P-wave duration timer coupled to the sensing system that determines durations of sensed P-waves and a pacing control that varies the delay time responsive to determined P-wave durations.

20

8. The implantable medical device of claim 6, further including a P-wave duration timer coupled to the sensing system that determines durations of sensed P-waves and a pacing control that varies the delay time in an inverse relation to determined P-wave durations.

25

9. The implantable medical device of claim 1, wherein the sensing system senses P-waves of the heart and wherein the implantable medical device includes a P-wave alternans analyzer that analyzes a selected

30

09934901 0815011  
T00000 T00000

characteristic of sensed odd and even P-waves and wherein the discriminator determines if the difference between the selected characteristic of the odd and even P-waves exceeds a predetermined criterion.

5

10. The implantable medical device of claim 1, wherein the sensing system senses P-waves of the heart, wherein the selected characteristic of the sensed atrial activity is spectral energy distribution of sensed P-waves, and wherein the implantable medical device includes a spectral analyzer that performs spectral energy distribution analysis of the sensed P-waves.

10

11. The implantable medical device of claim 1, wherein the sensing system includes a broad near-field atrial activity sensor.

15

12. The implantable medical device of claim 1, wherein the sensing system includes a near-field atrial activity sensor and a broad near-field atrial activity sensor.

20

13. The implantable medical device of claim 1, wherein the pulse generator circuit includes a right atrial pulse generator and a left atrial pulse generator.

25

14. The medical device of claim 1, further including a pacing control coupled to the pulse generator circuit that causes the pulse generator circuit to terminate the delivery of atrial arrhythmia prevention pacing pulses to the heart when the selected characteristic of the sensed atrial activity satisfies a second predetermined criterion.

15. An implantable medical device comprising:

signal processing means for detecting an interatrial  
conduction disturbance of a heart; and

pulse generator circuit means for delivering atrial arrhythmia  
prevention pacing pulses to the heart responsive to the detection of  
the interatrial conduction disturbance.

5

16. The implantable medical device of claim 15, wherein the  
interatrial conduction disturbance is a P-wave duration in excess of a  
predetermined criterion and wherein the signal processing means includes  
P-wave duration timing means for determining durations of detected P-  
waves.

10

17. The implantable medical device of claim 15, wherein the  
interatrial conduction disturbance is an average P-wave duration in excess  
of a predetermined criterion and wherein the signal processing means  
includes P-wave duration timing means for determining durations of  
detected P-waves and duration averaging means for averaging determined  
P-wave durations.

15

18. The implantable medical device of claim 15, wherein the  
interatrial conduction disturbance is an interatrial delay time in excess of a  
predetermined criterion, wherein the implantable medical device includes  
first detecting means for detecting right atrial activations and second  
detecting means for detecting left atrial activation, and wherein the signal  
processing means includes interatrial delay timing means for timing  
interatrial delay times between activations detected by the first detecting  
means and the second detecting means.

20

25

19. The implantable medical device of claim 15, wherein the atrial  
arrhythmia prevention pacing pulses are atrial overdrive pacing pulses and

30

wherein the pulse generator circuit means includes an atrial overdrive pulse generator means for providing atrial overdrive pacing pulses to the heart responsive to the detection of the interatrial conduction disturbance.

5           20. The implantable medical device of claim 15, wherein the pulse generator means includes atrial pacing means for delivering an atrial pacing pulse a delay time after a detected P-wave.

10           21. The implantable medical device of claim 20, further including P-wave duration timing means for determining durations of detected P-waves and control means for varying the delay time responsive to determined P-wave durations.

15           22. The implantable medical device of claim 20, further including P-wave duration timing means for determining durations of detected P-waves and pacing control means for varying the delay time in an inverse relation to determined P-wave durations.

20           23. The implantable medical device of claim 15, wherein the interatrial conduction disturbance is a selected difference between detected odd and even P-waves exceeding a predetermined criterion and wherein the signal processing means includes means for determining if the selected difference between the odd and even P-waves exceeds the predetermined criterion.

25           24. The implantable medical device of claim 15, wherein the interatrial conduction disturbance is a predetermined spectral energy distribution of detected P-waves, and wherein the signal processing means includes spectral analyzing means for performing spectral energy  
30           distribution analysis of the detected P-waves.

25. The implantable medical device of claim 15, wherein the signal processing means includes a broad field atrial activity detector.

5           26. The implantable medical device of claim 15, wherein the signal processing means includes a near-field atrial activity detector and broad field atrial activity detector.

10           27. The implantable medical device of claim 15, wherein the pulse generator circuit means includes a right atrial pulse generator and left atrial pulse generator.

15           28. The implantable medical device of claim 15, further including pacing control means for causing the pulse generator circuit means to terminate the delivery of atrial arrhythmia prevention pacing pulses to the heart when the interatrial conduction disturbance has subsided.

20           29. A method of pacing a heart to prevent an atrial arrhythmia, the method including the steps of:  
              detecting an interatrial conduction disturbance of the heart;  
              and  
              delivering atrial arrhythmia prevention pacing pulses to the heart responsive to detecting the interatrial conduction disturbance.

25           30. The method of claim 29, wherein the interatrial conduction disturbance is a P-wave duration in excess of a predetermined criterion and wherein the method further includes the step of determining durations of detected P-waves.

31. The method of claim 29, wherein the interatrial conduction disturbance is an average P-wave duration in excess of a predetermined criterion and wherein the method further includes the steps of determining durations of detected P-waves and averaging the determined P-wave durations.

32. The method of claim 29, wherein the interatrial conduction disturbance is an interatrial delay time in excess of a predetermined criterion and wherein the method further includes the steps of detecting right atrial activations, detecting left atrial activations, and timing interatrial delay times between right atrial activation detection and left atrial activation detection.

33. The method of claim 29, wherein the atrial arrhythmia prevention pacing pulses are atrial overdrive pacing pulses and wherein the delivering step includes providing atrial overdrive pacing pulses to the heart.

34. The method of claim 29, further including the step of detecting P-waves of the heart and wherein the delivering step includes delivering an atrial pacing pulse a delay time after each detected P-wave.

35. The method of claim 34, further including the step of determining durations of detected P-waves and wherein the delivering step further includes varying the delay time responsive to determined P-wave durations.

36. The method of claim 34, further including the step of determining durations of detected P-waves and wherein the delivering step

further includes varying the delay time in an inverse relation to determined P-wave durations.

37. The method of claim 29, further includes the step of detecting P-waves of the heart, wherein the interatrial conduction disturbance is a selected difference between detected odd and even P-waves exceeding a predetermined criterion, and wherein the detecting step includes determining if the selected difference between the odd and even P-waves exceeds a predetermined criterion.

10

38. The method of claim 29, further including the step of detecting P-waves of the heart, wherein the interatrial conduction disturbance is a predetermined spectral energy distribution of detected P-waves, and wherein the method further includes the step of performing spectral energy distribution analysis of the detected P-waves.

15

39. The method of claim 29, including the further step of sensing broad near-field atrial activity.

20

40. The method of claim 29, including the further step of sensing near-field atrial activity and far-field atrial activity.

41. The method of claim 29, wherein the delivery step includes delivering right atrial pacing pulses and left atrial pacing pulses.

25

42. The method of claim 29, further including the step of terminating the delivery of the atrial fibrillation prevention pacing pulses to the heart when the interatrial conduction disturbance ceases.